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SERIES Q: SWITCHING AND SIGNALLING

Clauses applicable to CCITT standard systems – Control of echo suppressors

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CONTROL OF ECHO SUPPRESSORS AND ECHO CANCELLERS BY INTERNATIONAL SWITCHING CENTRES

Reedition of CCITT Recommendation Q.115 published in the Blue Book, Fascicle VI.1 (1988)

NOTES

1 CCITT Recommendation Q115 was published in Fascicle VI.1 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation Q.115

CONTROL OF ECHO SUPPRESSORS AND ECHO CANCELLERS BY INTERNATIONAL SWITCHING CENTRES

3.1 *General*

In order to achieve transmission objectives on long automatic and semi-automatic telephone connections, it is necessary to take into account the effects of echo. A general discussion of echo considerations is given in Recommendation Q.42 which is an extract of Recommendation G.131. The characteristics of terminal half-echo control devices are given in Recommendations G.161 [1] and G.164 [2]. The characteristics of echo cancellers are given in Recommendation G.165 [3].

In order to achieve optimum echo control for each call, it is necessary to control both types of echo control devices.

This can be carried out at switching centres only if sufficient information is available to coordinate an overall control action.

Logical means to obtain pertinent information and the switching considerations governing its practicable use are detailed below. Control based on the transfer of signals between switching centres is given particular attention. Self-contained control action such as tone disablement of echo suppressors and echo cancellers for data transmission is not within the scope of this Section.

In the cases to be discussed, control methods will be applied at international exchanges (CTs), but it is recognized that in some countries covering large geographic areas it may be appropriate to extend the control methods into national networks.

The actions described in §§ 3.5 to 3.8 about the analysis of information and the decision to be taken in an outgoing transit or incoming international exchange are summarized in the SDL flowchart of the Annex A.

Annex A does not cover the handling of echo control devices in the case of different bearer services and CCITT Signalling System No. 7.

3.2 *Terminology*

a) Subsequent discussion of control measures will refer to the standard terminal half-echo suppressor specified in Recommendation G.164 [2] and the echo cancellers specified in Recommendation G.165 [3]. The terms echo suppressor and echo canceller will be used to denote these devices. The term echo control device will comprise both, echo suppressors and echo cancellers.

b) Two means of introducing echo control devices are considered as acceptable, these are, the use of permanently associated echo control devices and the use of echo control devices inserted from a common pool of echo control devices.

c) With respect to control of permanently associated echo control devices control actions are said to enable or disable.

d) With respect to echo control devices provided from pools, control actions are concerned with inserting or not inserting.

e) The signals assigned in Systems R2, No. 6 and No. 7 (and reserved in System No. 4) for echo control equipment control are in most cases a means to guide subsequent exchanges in taking necessary action with respect to possible introduction of an incoming echo control device. Thus the descriptive phrases associated with the various signalling systems, as given below, convey comparable meaning in the control plan.

   Systems No. 4 and R2: incoming half-echo suppressor (half-echo canceller) required;

   Systems No. 6 and No. 7: outgoing half-echo suppressor (half-echo canceller) included in the connection.

f) A secondary signalling function related to echo control provides for the possibility that echo control device may not be available at an originating CT. In this case responsibility for both outgoing and incoming echo control device may be delegated by signal.

g) A long circuit is considered as one which, if used by itself, would require echo control.

h) A short circuit is considered as one which, if used by itself, would not require echo control.

3.3 *Compatibility of echo control devices and signalling equipment*

3.3.1 Arrangements should be incorporated in the switching equipment to prevent echo suppressor and echo canceller action from disturbing simultaneous forward and backward signalling via the speech paths.

For this case typical arrangements are:

i) locating the echo control device on the switching side of the signalling equipment;

ii) inhibiting the action of echo control device located on the line side of the signalling equipment by means of an appropriate condition extended from the signalling equipment to the echo control device while signalling is in progress.

Note 1 – The standard half-echo suppressor (Recommendations G.161 [1] and G.164 [2]) if located on the line side of line signalling equipment may adversely affect signalling. This difficulty is possible because with the new standard half-echo suppressor normal operation will at times cause 6 dB additional loss to appear in the path to a line signalling receiver. Operating margins are correspondingly reduced. For example, with signalling receivers for System No. 5 as specified in Recommendation Q.112, signalling reliability could be impaired. Accordingly, adequate operating margins should be assured or the echo suppressor should not be located on the line side of line signalling receivers. With regard to inter-register signalling which requires simultaneous transmission in both directions, similar considerations call for disabling the echo suppressors while inter-register signalling is in progress in order to prevent the 6 dB loss.

Note 2 – Echo cancellers will not introduce any fixed loss during in-band signalling. But they can cause a problem during the continuity check used in CCITT Signalling Systems No. 6 (Recommendation Q.271) and No. 7 (Recommendation Q.724), or with compelled signals having the same frequency(ies) on both directions of transmission in Signalling System No. 5 (Recommendation Q.112) where the received signal is processed through the existing echo path model and produces an interfering signal in the return path.

Note 3 – Some echo control devices are capable of internally providing either signalling bypass or an appropriate internal function which permits transparent operation to in-band signalling or other in-band tones.

3.3.2 Arrangements should be incorporated in the Systems No. 6 and No. 7 equipment to prevent echo suppressor action from disturbing the procedure for making the continuity check of the speech path. Echo suppressor and echo cancellers must be permanently disabled, if a circuit is used for common channel signalling.

3.4 *Operation without signals*

In Signalling Systems No. 5 and R1, signals are not available for echo control information. In System No. 4 a signal may be applied only if multilateral or bilateral agreements authorize its use. Accordingly, the recommended control plan relies on means other than signals in cases where it has not been found practicable to provide signals. In the case of System No. 5, the normal field of application to long circuits typically indicates the presence of echo control device. In the case of System R1, regional control procedures not requiring signals are applicable.

3.5 *Analysis of information at an outgoing international exchange*

The outgoing international exchange, hereafter designated “A”, must make a decision with respect to its echo control requirements at the time an outgoing circuit is selected. Unless echo control devices are not available, one or more of the following items of information should influence this decision:

i) country code of destination and possibly some additional address digits;

ii) information about the actual routing of the call;

iii) nature of outgoing international circuit at A (e.g. satellite circuit);

iv) nature of incoming national circuit at A;

v) signals received over the incoming national circuit at A;

vi) requested bearer service (see Recommendation I.231 [4]).

With respect to iii) and iv), the characteristic of primary interest is propagation time. Two general categories, long and short, are the basis of control action. See §§ 3.2 g) and h) above, for definition of terminology.

3.6 *Decision to be taken at the outgoing international exchange*

If the factors i) to vi) in § 3.5 above indicate that there is no need to provide echo control devices on a particular connection, the outgoing exchange should act accordingly and advise subsequent exchanges by signal or other appropriate means, of its decision.

If the information available indicates that the connection to be established will require echo control and if it is known that an outgoing echo control device is not already provided in the national network, then the outgoing exchange

should provide for the outgoing echo control device. The outgoing exchange should also, if signals are available, indicate by signal to subsequent exchanges as appropriate what action it has taken.

In the event that an outgoing exchange is unable to provide an outgoing echo control device when a need is known, it may call for cooperative action. (Signal I-11 in System R2 is specifically assigned to make possible a cooperative transfer of responsibility for echo control device control from an originating CT to a transit CT. The signal outgoing half-echo suppressor not included could be used with Systems No. 6 and No. 7, but such an application would in effect assume that a modern exchange found sufficient reason to displace an outgoing echo control device from its preferred location.)

3.7 *Decision to be taken at an international transit exchange*

The decision at an international transit exchange depends on an assessment of switching and signalling information available after the transit CT has selected an outgoing circuit. Information similar to that listed in 3.5 i) to vi) above is of interest.

a) When the first transit CT knows that an outgoing echo control device has not yet been provided closer to the call source by a signal of CCITT Systems No. 6, 7 and R2, or by bilateral agreements for specific exceptions, the transit CT should consider the outgoing circuit selected, the ultimate call destination and such other information as indicated above. If a connection requiring echo control may result, an outgoing echo control device should be enabled or inserted at the first transit CT.

b) When the transit CT concerned knows that an outgoing echo control device is located closer to the call source, the question to be decided is the location of the incoming echo control device. The incoming echo device is located at the transit CT only when a location nearer to the called party is not practicable. Specifically, an exception may result when the transit CT selects a short terminal circuit equipped with CCITT Signalling Systems No. 4, 5, or R1. In this case, an incoming echo control device should be enabled or inserted at the transit CT.

c) It follows from the above that in every case where an international transit centre interconnects two circuits and knows that echo control device will be provided at a preceding location and also at a more distant location, the transit centre should disable or not insert its own echo control device. (Full echo control device is not covered in the control plan and should not be affected by the procedures described in this Section.)

d) It is, of course, commonly the case that an outgoing echo control device has not been introduced at the outgoing exchange because none is required. When the transit exchange has reason to know of such a situation, it should not introduce an echo control device and should advise the subsequent exchange when possible that an incoming echo control device is not required (or equivalently, that an outgoing echo control device has not been introduced).

e) In the case of a routing where both an incoming and outgoing echo control device has already been inserted at earlier points, the transit exchange should advise the subsequent exchange, where possible, that an incoming half echo control device is not required.

3.8 *Decision to be taken at the incoming international exchange*

Short circuits equipped with CCITT Systems No. 5, R1 and No. 4 (unless bilateral agreements are reached), provide no signals at the incoming CT for selective use of echo control devices. As a result, in the absence of separate circuit groups on the same route or other alternatives, the economic choice is to omit echo devices. In the case of a call that has passed through a transit exchange en route to the incoming exchange, the requirement for an incoming echo control device should then be met at the preceding CT as covered in § 3.7 b) above.

With CCITT Systems No. 6, 7, R2 and 4 (assuming multilateral or bilateral agreement) selective use of echo control devices on short terminal links is a basic option. Therefore, the terminal CT acts in accordance with the control signal received. When an outgoing echo control device has been included at a preceding CT, the incoming CT should enable or insert an incoming echo control device.

When no echo control device has yet appeared elsewhere in the connection, none should be enabled or inserted at the incoming CT.

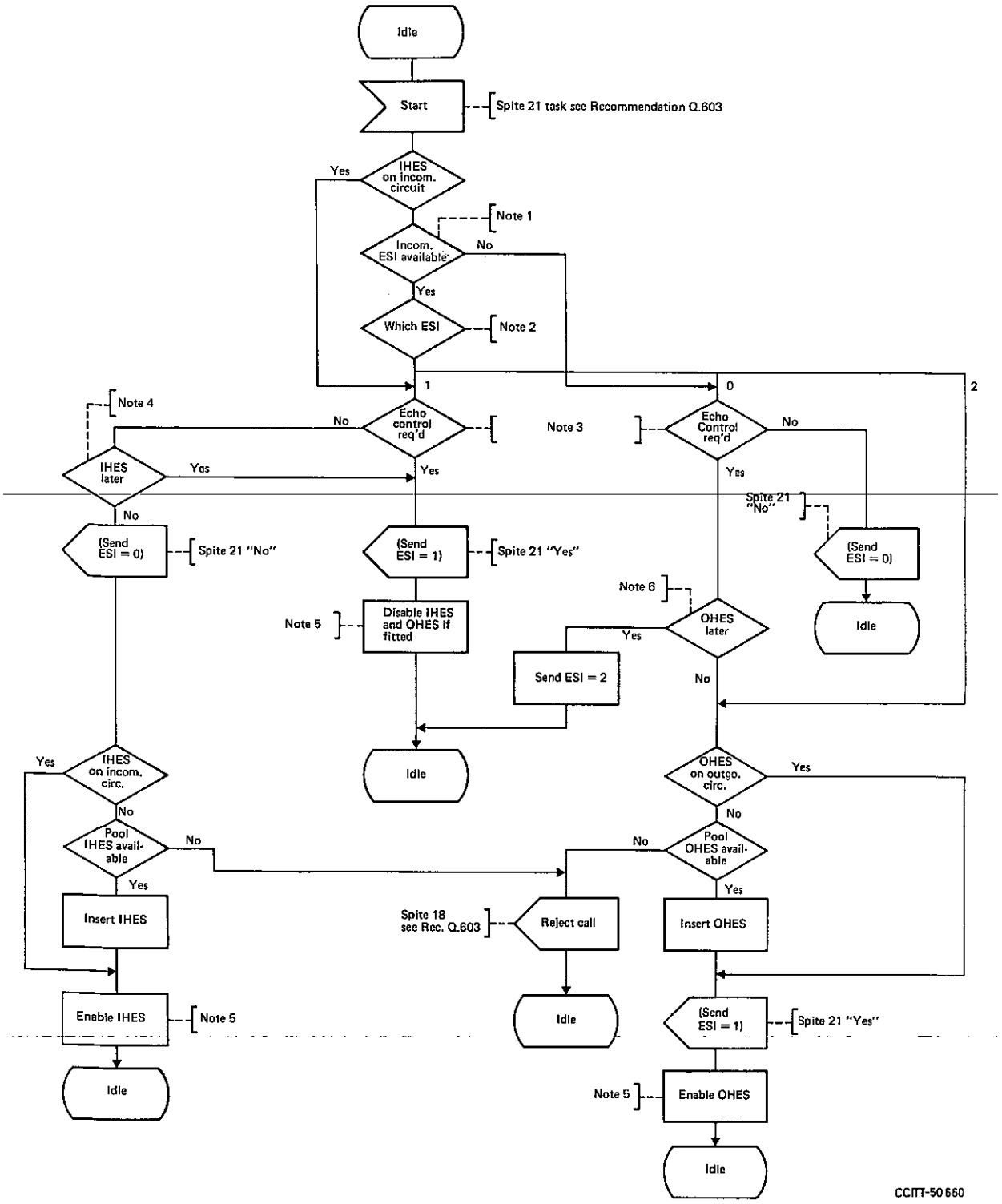
3.9 *Other considerations*

It is recognized that when echo control devices are inserted from pools, there is a small probability that no echo control device will be available when needed. In this case an (equipment) congestion signal should be given to the calling subscriber.

Nothing in this Recommendation should be construed as discouraging control measures which may supplement the plan described and lead to improved results in specific situations. For example, regional procedures which introduce loss to control echo may be arranged to satisfy both regional and international needs on a selective basis. In addition for multiple ISC in one country the procedure of Annex B may be applied. It is recognized that possibilities for echo control have not been exhausted. If switching and signalling equipment have a changed role in the application of future procedures, this Recommendation will be subject to revision.

ANNEX A
(to Recommendation Q.115)

Call processing logic - Echo suppressor control



(See the Notes at the next page.)

Call processing logic - Echo suppressor control diagram notes

Note 1 – "Yes" where incoming signalling system provides echo suppressor indicators (ESI). For terminal R2 calls ESI is only available on request using A14. Signal A14 should only be returned where an IHES can be inserted.

Note 2 – ESI = 0, OHES not includes, IHES not required.

ESI = 1, OHES included, IHES required.

ISE = 2, OHES not included, OHED required.

Note 3 – Analysis of digits indicates a long connection which requires or already has echo suppressors; or route analysis indicates that permanent echo suppressors are fitted.

Note 4 – IHES should be connected as close to called subscriber as possible. This decision relates to the capability of the next or a later exchange to connect echo suppressors from a pool.

Note 5 – During the "register activated" phase all echo suppressors should be disabled. Enable or disable actions refer to the period after register deactivation, except for System R2 where it refers to the period after the reception of the answer signal.

Note 6 – This exchange cannot connect OHES, but by bilateral agreement is to be connected at next exchange. The indicator ESI = 2 is only used in Signalling System R2 and can only be used between the outgoing R2 international exchange and the first transit exchange.

ESI Echo suppressor indicator.

IHES Incoming half echo suppressor.

OHES Outgoing half echo suppressor.

SPITE 21 Incoming half echo suppressor to be included at distant end?
See Recommendation Q.603.

ANNEX B
(to Recommendation Q.115)
Echo suppressor control on inter-ISC circuits within a single country

In the case where an international transit call is connected through multiple ISCs in a single country in tandem, the following problem may arise with the control of echo suppressors.

Referring to Figure B-1/Q.115, which shows such a connection with two possible outgoing international circuits, one echo suppressed (Exchange B), and one unsuppressed (Exchange C). Exchange E does not have echo suppressors in a pool. Exchange D does not know whether or not the outgoing circuit from Exchange E is provided with echo suppressors. It is not therefore able to control the half echo suppressor HESd, since there may be an incoming half echo suppressor later in the connection.

In order to overcome this problem, a backward signal can be used from Exchange E, which informs Exchange D of the provision of echo suppressors on the outgoing international circuit.

Two methods are currently proposed by Administrations to provide these backward indications, these are detailed below:

i) A backward signal to Exchange D indicating the presence or absence of echo suppressors on the outgoing international circuit is generated by Exchange E as soon as the outgoing circuit has been selected. If a call failure situation subsequently arises and a repeat attempt is made then a new outgoing international circuit is chosen, and a further signal is passed back to Exchange D indicating the presence or absence of echo suppressors on this new circuit. HESd is then enabled, or disabled according to the last backward echo suppressor indicator received from Exchange E.

ii) In this case HESd is initially disabled, and remains so unless a signal is received from Exchange E indicating the absence of echo suppressor on the outgoing circuit. Exchange E only transmits such a signal if the outgoing international circuit has no echo suppressor provided, and will delay transmission of the signal until the address complete signal (or equivalent) is ready to be sent.

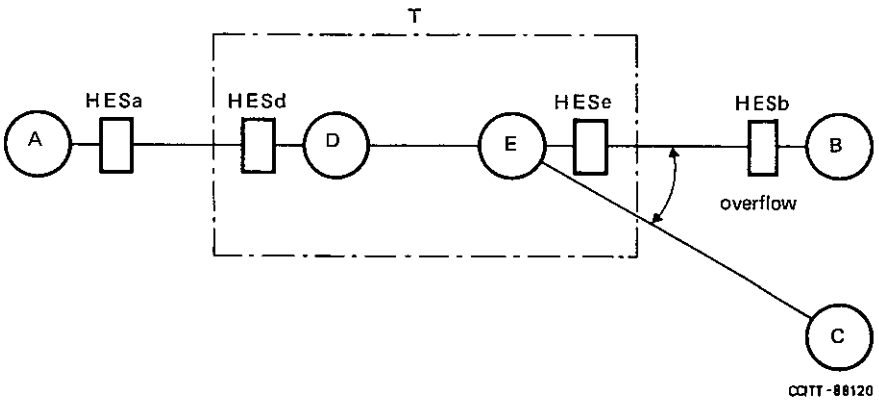


FIGURE B-1/Q.115
Echo control on multiple ISCs in a country

References

[1] CCITT Recommendation *Echo suppressors suitable for circuits having either short or long propagation times*, Volume III of Orange Book, Recommendtion G.161.

[2] CCITT Recommendation *Echo suppressors*, Volume III, Recommendation G.164.

[3] CCITT Recommendation *Echo cancellers*, Volume III, Recommendation G.165.

[4] CCITT Recommendation *Circuit-mode bearer services categories*, Volume III, Recommendation I.231.

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